State of California—Health and Human Services Agency
California Department of Public Health

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May 4, 2015

TO: Participants in the March 2015 Proficiency Test in Forensic Alcohol Analysis

SUBJECT: Assigned Values and Acceptable Ranges for the March 2015 Proficiency Test
              in Forensic Alcohol Analysis

Attached is a summary of the descriptive statistics for the March 2015 proficiency test in forensic alcohol analysis. Included here are the target formulation values, the true values as determined by the Department's analyses, the peer-group or consensus values and the standard deviations, and a graphical summary of the distribution of participant results.

Historically, the Department has determined the acceptable limits of performance based on reported results that are within the range representing ±5% of the 99% confidence interval of the peer group mean, where the range has been truncated to two significant figures (Table 1). This range is described as the "Tier #2 interval." The Department also calculates a "Tier #1 interval," which represents the range of reported results that are within ±5% of the 95% confidence interval of the peer group mean where the range is based on the results reported to three significant figures. Tier #1 is expected to include those laboratories demonstrating a high degree of accuracy. The second, wider tier would include those laboratories not as close to the central tendency as the first tier, but still accurate and therefore adequately competent. Again, historically, the Department has used the wider second tier to evaluate the laboratories' results.

The IUPAC International Harmonized Protocol for the Proficiency Testing of Analytical Chemistry Laboratories (Harmonized Protocol) recommends the use of z-scores for evaluating proficiency test data. However, the Harmonized Protocol notes that that the interpretation of the z-scores is based on the normal distribution of reported results, in which case the z-scores can be expected to follow the standard normal distribution. As indicated in Table 2, the results for Pool 02175 in this proficiency test were not found to be normally distributed. Accordingly, the use of z-scores may not be completely appropriate, but they still may be useful to identify outlier and/or warning level results. The expression for calculating a z-score is included in Table 2. Generally a score between -2 and +2 ($|z| \leq 2$) is considered satisfactory or acceptable. A score outside the range -3 to +3, inclusive ($|z| \geq 3$) is considered unsatisfactory or unacceptable and the laboratory must take corrective actions. Z-scores between -3 and -2 or +2 and +3 ($2 < |z| < 3$) are considered questionable and these two ranges should be used as warning limits. Scores within the warning limit ranges in two or more consecutive test events could be considered unacceptable.

The proficiency test results expressed as *z*-scores for the participants whose results were used to determine the peer group mean and statistics in the March 2015 test are summarized in Figure 4. Participants are identified by codes. An attachment to this letter provides codes for participants from your laboratory. The figure is provided for educational purposes only and was not used to formally evaluate a laboratory's performance.

Another approach for evaluating proficiency test data, which is non-parametric and does not require the data to be converted to a standard normal form, divides the test data at regular intervals or quantiles. The quartile is a type of quantile: the first quartile (Q_1) is defined as the middle number between the lowest number and the median of the data set. The second quartile (Q_2) is the median of the data set. The third quartile (Q_3) is the middle value between the median and the highest value of the data set. The interquartile range (IQR), a measure of the dispersion of the data, is the difference between the upper and lower quartiles (IQR = Q_3 − Q_1). Boundaries (called fences) are set at Q_1 – 1.5 IQR (lower fence) and Q_3 + 1.5 IQR (upper fence) to identify potential outliers in the tails of the distribution. In Figure 3, the data from the two pools are presented as box and whisker or Tukey plots with the quartiles and fences shown. The median of the data is shown by a black line and the mean of the data is shown by a red line inside the box. These figures can be used by the participants to evaluate their data.

Sincerely,

Clay Larson, Chief
Abused Substances Analysis Section
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Statistical Data for March 2015 Proficiency Test in Forensic Alcohol Analysis

Table 1   CDPH Tier #1 and Tier #2 Acceptable Ranges

Pool	Peer Group Mean	Tier #1	Tier #2
#1	0.130	0.121 – 0.139	0.12 – 0.14
#2	0.209	0.196 – 0.222	0.19 – 0.22

Table 2   Summary of Test Pool Data

Parameter	POOL 1 (02175)		POOL 2 (02235)	
Pre-distribution Data	Target Value	0.13%	Target Value	0.21%
	True Value[1]	0.128	True Value[1]	0.206
	Standard Deviation[2]	0.0011	Standard Deviation[2]	0.0019
Descriptive statistics	Mean	0.130	Mean	0.208
	Adjusted Mean[2]	0.130	Adjusted Mean[2]	0.209
	Standard Error[3]	0.0004	Standard Error[3]	0.0007
	Median	0.130	Median	0.208
	Standard Deviation	0.0027	Standard Deviation	0.0049
	Minimum	0.122	Minimum	0.196
	Maximum	0.137	Maximum	0.219
	Count	56	Count	52
Descriptive statistics (box plot)	Q1 (25%)	0.128	Q1 (25%)	0.206
	Q3 (75%)	0.131	Q3 (75%)	0.212
	IQR	0.003	IQR	0.006
	Lower Fence	0.124	Lower Fence	0.197
	Upper Fence	0.136	Upper Fence	0.221
Histogram	Figure 1		Figure 2	
Normal distribution?[4]	NO		YES	
Box Plot (SigmaPlot)	Figure 3		Figure 3	
Robust mean, X*	0.130		0.208	
Robust standard deviation, σ_{rob}	0.0017		0.0035	
Fitness-for-purpose standard deviation, σ_p	0.0032		0.0052	
Consensus value (X_a) determined as Mode ($\mu_{1/2}$) of Gaussian Kernel distribution	0.1296		0.2080	
Uncertainty of the consensus value, X_a , S.E.[5]	0.0003		0.0006	
X_a ± S.E.	0.1296 ± 0.0003		0.2080 ± 0.0006	
z-score	$z = \dfrac{X - X_a}{\sigma_p}$		$z = \dfrac{X - X_a}{\sigma_p}$	

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[1] Based on CDPH's Headspace Gas Chromatographic Method
[2] Mean determined from participant data after the removal of outlier(s)
[3] Standard Error of the Mean
[4] Shapiro-Wilk test used at 0.05 significance level.

[5] Determined as Standard Error of Mode using bootstrap simulation technique with bandwidth of $0.75*\sigma_p$
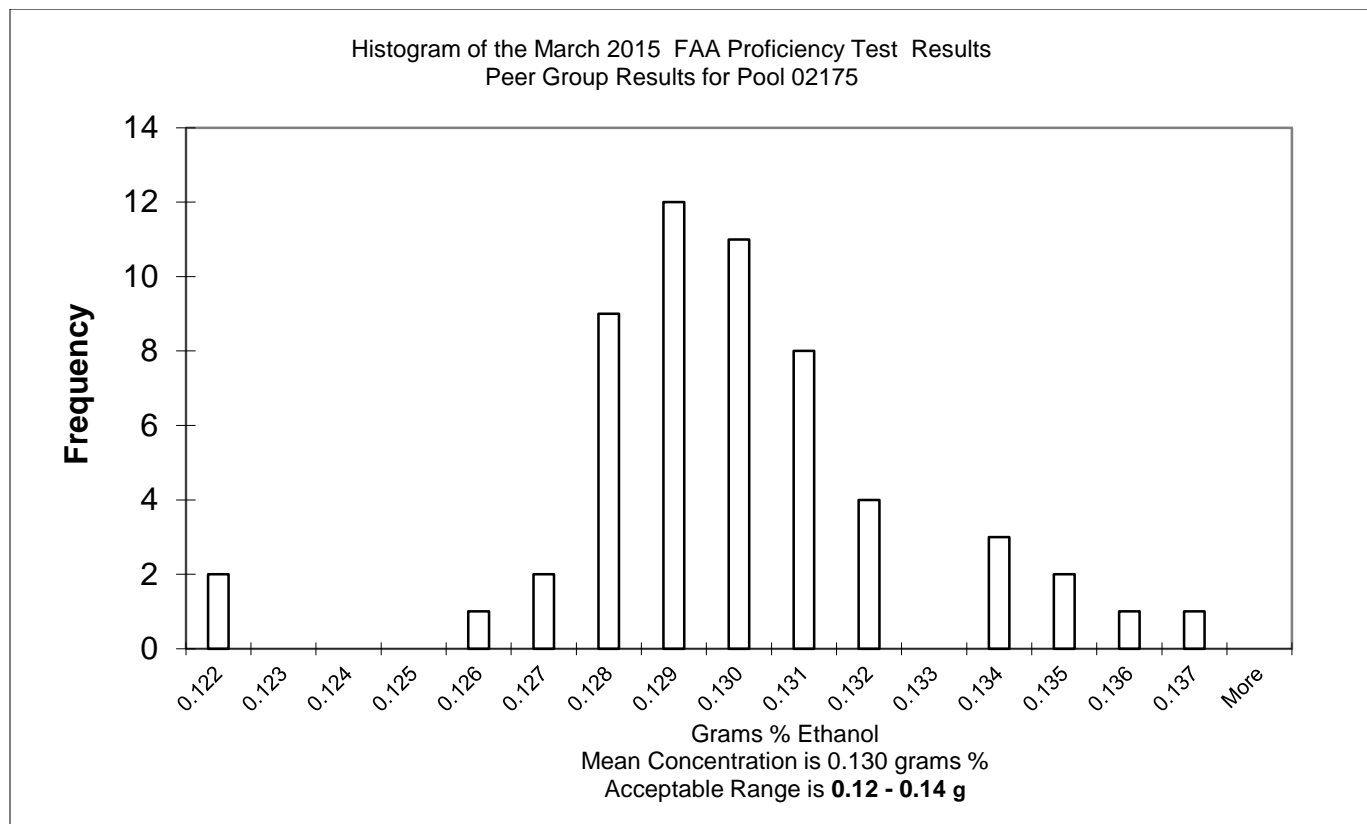
Figure 1

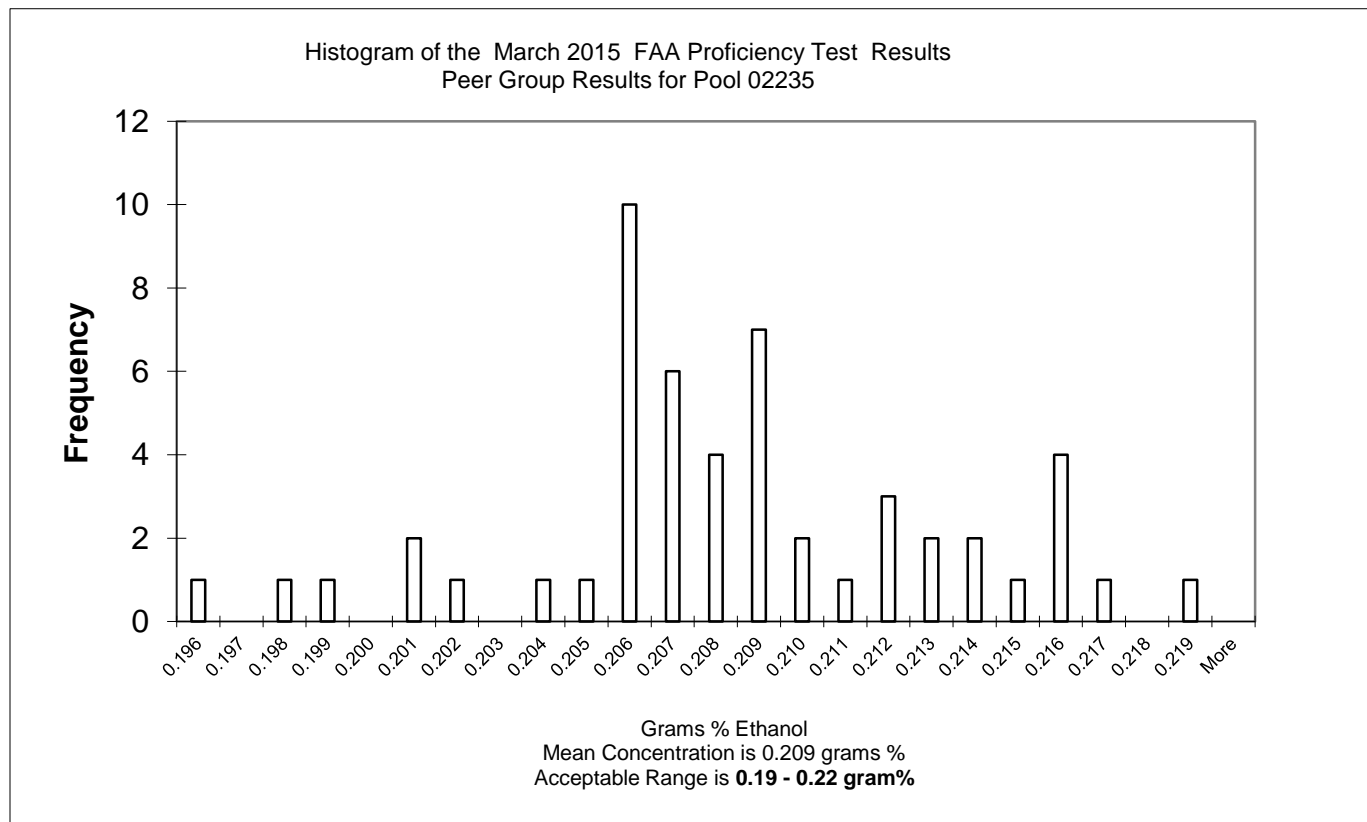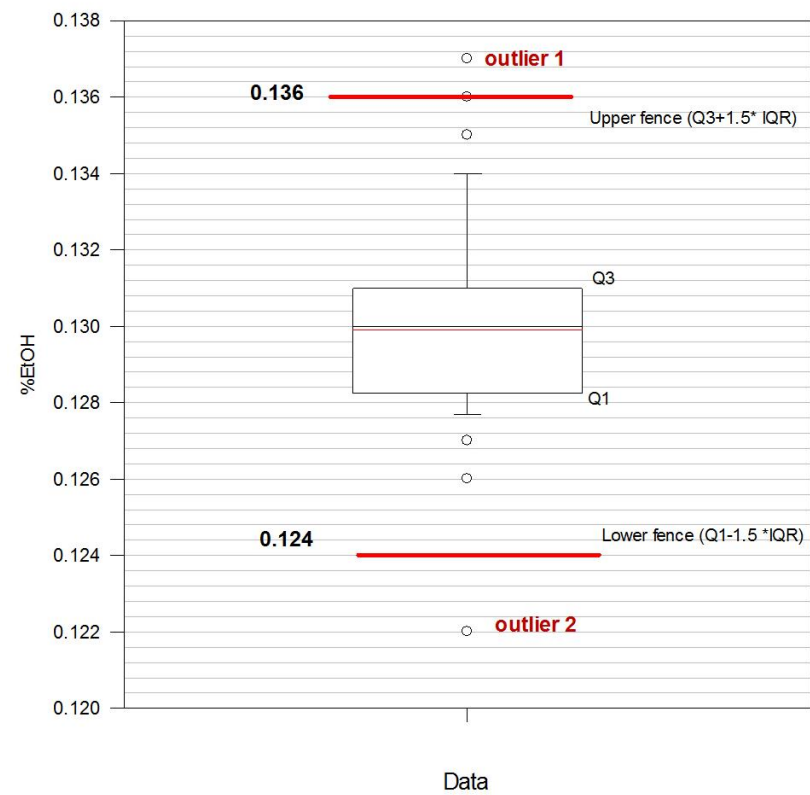Histogram of the March 2015 FAA Proficiency Test Results
Peer Group Results for Pool 02175

Grams % Ethanol
Mean Concentration is 0.130 grams %
Acceptable Range is **0.12 - 0.14 g**

Figure 2

Histogram of the March 2015 FAA Proficiency Test Results
Peer Group Results for Pool 02235

Grams % Ethanol
Mean Concentration is 0.209 grams %
Acceptable Range is **0.19 - 0.22 gram%**

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Figure 3 SigmaPlot analysis of pools 02175 & 02235
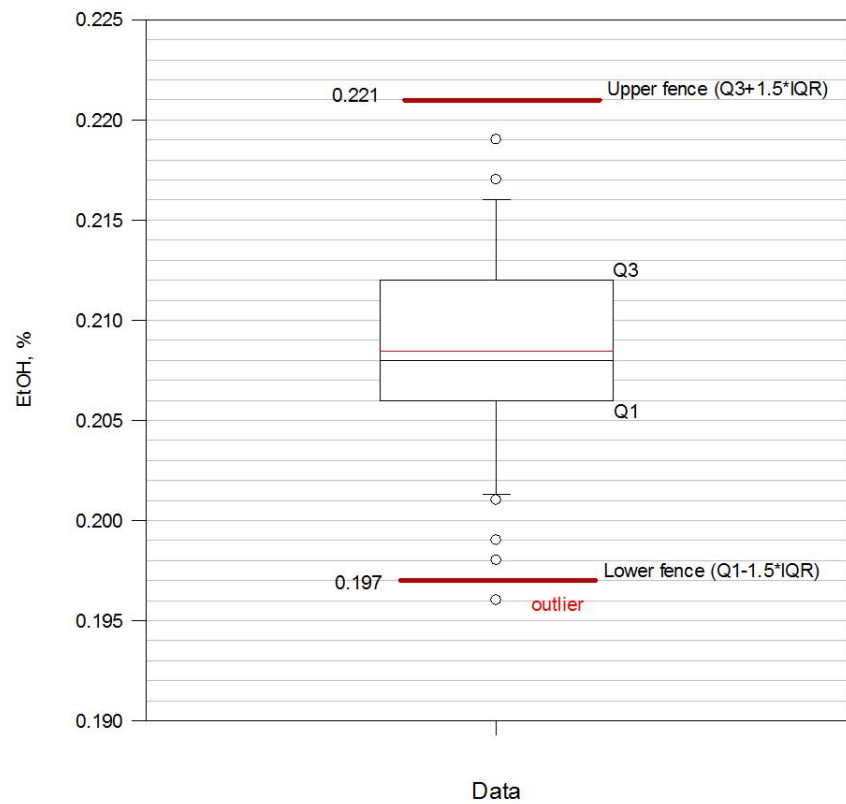
02175 Box Plot

02235 Box Plot

Figure 4

March 2015 Pools 02175 & 02235 Z-score (combined)

LABS' IDs : A through I, Candidates' IDs from c-1....c-14/Sample A number (e.g., Sample A005 is 5, A105 is 105....)